

WHAT IS CLAIMED IS:

1. An audio signal processing circuit for an audio reproduction apparatus at least having sound source located substantially at left and right sides to a listener, comprising:

5 a phase difference control portion which receives a left channel signal for the left sound source and a right channel signal for the right sound source, controls a phase difference between the left and right channel signals so as to produce a relative phase difference in the range of 140 degrees to 160 degrees, and outputs the phase difference controlled left and right channel signals for the left and right sound source, respectively.

15 2. An audio signal processing circuit according to claim 1, wherein the phase difference control portion produces the relative phase difference of 140 degrees to 160 degrees in a frequency region ranging from 200 Hz to 1 kHz.

20 3. A surround audio reproduction apparatus having a left and a right channels in front of a listener and a left and a right surround channels at left and right sides with respect to the listener, comprising:

25 a phase difference control portion which receives a left surround channel signal and a right surround channel signal,

controls a phase difference between the left and the right surround channel signals so as to produce a relative phase difference in the range of 140 degrees to 160 degrees, and outputs the phase difference controlled surround left and right channel signals for a left and a right surround sound source, respectively.

4. A surround audio signal processing circuit according to claim 3, wherein the left and the right surround sound sources are a virtual sound source produced by a sound image localization processing.

5. A surround audio signal processing circuit according to claim 3, wherein the phase difference control portion produces the relative phase difference of 140 degrees to 160 degrees in a frequency region ranging from 200 Hz to 1 kHz.

6. An audio reproduction method at least utilizing sound source located substantially at left and right sides to a listener, comprising the steps of:

controlling a phase difference between a left channel signal for the left sound source and a right channel signal for the right sound source so as to produce a relative phase difference in the range of 140 degrees to 160 degrees; and

outputting the phase difference controlled left and right channel signals for the left and right sound source, respectively.

- 5 7. A shuffler type audio signal processing circuit, comprising:

a first filter for producing a sum signal of a left channel signal and a right channel signal; and

10 a second filter for producing a differential signal of the left channel signal and the right channel signal;

wherein an accuracy of the second filter is higher than that of the first filter in a low frequency region.

- 15 8. A shuffler type audio signal processing circuit, comprising:

a first filter for producing a sum signal of a left channel signal and a right channel signal; and

a second filter for producing a differential signal of the left channel signal and the right channel signal;

20 wherein the first filter and the second filter are FIR filter, and the tap number of the second filter is larger than that of the first filter.

- 25 ~~9. A shuffler type audio signal processing circuit according to claim 7, wherein the second filter is composed of a filter bank.~~

10. A shuffler type audio signal processing circuit according to claim 9, wherein the filter bank performs down-sampling by the larger number for the lower frequency component.

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11. A shuffler type audio signal processing circuit, comprising:

a first filter for producing a sum signal of a left channel signal and a right channel signal; and

10 a second filter for producing a differential signal of the left channel signal and the right channel signal;

wherein the first filter is FIR filter, and the second filter is composed of a parallel connection of FIR filter and secondary IIR filter.

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12. A shuffler type audio signal processing circuit according to claim 11, wherein the second filter comprises:

FIR filter, and

secondary IIR filter connected in parallel to the FIR
20 filter at one of the intermediate taps or the end tap thereof.

13. An audio signal processing circuit according to claim 7, wherein the circuit is used as a cross-talk cancel filter.

14. An audio signal processing circuit according to claim 7,
wherein the circuit is used as a sound image localization
processing filter.

5 15. A filter comprising:

FIR filter having a plurality of taps,

IIR filter whose input is connected to one of the
intermediate taps or the end tap of the FIR filter, and

an adding means which adds outputs of the FIR filter and
10 the IIR filter.

16. A shuffler type audio signal processing method,
comprising the steps of:

performing a first filtering process for a sum signal
15 of a left channel signal and a right channel signal; and

performing a second filtering process for a differential
signal of the left channel signal and the right channel signal

wherein an accuracy of the second filtering process is
higher than that of the first filtering process.

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